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On the Size of Sheepskin Effects: A Meta-Analysis

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Abstract
The authours use information gathered from 122 studies on the effects of high school diplomas on wages in different countries worldwide to carry out a meta-analysis that shows high school diplomas have a statistically significant effect on wages of nearly 8%. This effect varies whether the country is away from the tropics or whether factors such as gender, race, and continent are taken into account. The results also reveal the existence of a publication bias that tends to increase the magnitude of the sheepskin effect. Nevertheless, when the former is factored into the analysis the latter remains statistically significant.

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1 Introduction

The degree equation was first developed by Hungerford and Solon in 1987 and is usually known as the "sheepskin effect equation". Under the sheepskin hypothesis workers are rewarded not only for the productive-enhancing contribution of schooling, but also for obtaining the diploma that comes with completing a particular level of schooling. In consequence, wages will rise faster with extra years of schooling when the extra years also convey a diploma. Using cross-sectional data, Hungerford and Solon (1987) found that there is a return for each year of education and an additional significant return on the years during which a diploma or degree is earned. Since then many studies have been carried out to test the hypothesis and measure the sheepskin effect. For our review most of this research was completed in Brazil (29.51%), the United States (24.59%), and Colombia (10.66%).

While it is evident that there may be measurement errors in educational attainment when empirical research is based on data of self-reported education levels (see Card, 1999; Kane et al., 1999) and that ordinary least squares (OLS) estimates overstate the effects of a diploma/degree, we also must observe that if sheepskin effects persist across different countries, their importance should not be neglected. The existence of diploma/degree effects is obviously important when it comes to establishing educational policies in any country because of the high social costs involved, particularly in developing countries.

One of the possible ways to determine the magnitude of sheepskin effects is by examining various publications on this subject. In this article, we conduct a meta-analysis of the diploma/degree equation that centers specifically on the effect of high school diplomas. We have reviewed a total of 24 comparable published articles and 122 comparable estimates of the sheepskin effects that cover 15 different countries, including, among others, Libya, the Philippines, and Egypt. Our findings show that the effect of a schooling degree is not only statistically significant but depends on factors such as closeness to the tropics, gender, race, and continent. The article provides an important contribution in that it shows that the effect of a high school diploma on wages is real in a statistical sense. In other words, the said effect is not statistically equal to zero. Additionally, we find that the size of the sheepskin effect is around 8% in the case of high school diplomas.

The article is organized as follows: Section 2 presents a brief review of the sheepskin (diploma/degree) effects literature; Section 3 discusses the sheepskin equation and the meta-analysis technique; Section 4 discusses relevant data; Section 5 reviews the results; and the last section provides the conclusions.

2 Brief review of the sheepskin effects

The contributions of Michael Spence (1973, 2002) and Kenneth Arrow (1973) gave rise to a considerable amount of research related to the debate on human capital and signaling. The theory of human capital postulated by Gary Becker (1964) contends that education (and on-the-job training) directly increases an individual's productivity thereby increasing his/her salary. According to this theory each additional year of schooling brings about a proportional salary increase. On the other hand, Spence's (1973) and Arrow's (1973) theories of both signaling and screening suggest that the benefits of obtaining a degree extend beyond salary increases because educational degrees provide either indications of a worker's productivity or the grounds for signaling or screening.

In the mid-1980s Thomas Hungerford and Gary Solon (1987: 175) found evidence to confirm, "wages will rise faster with each extra year of education when an extra year also conveys a certificate." Therefore, a diploma has its own value aside from the number of years of schooling. Their sheepskin equation shows the relationship between log wages and years of schooling as a discontinuous spline function with discontinuities at every diploma year.

Since Hungerford and Solon presented evidence of significantly larger returns to diploma years in the United States, many further attempts have been made. Using cohorts from 1979 and 1991 in a cross-section model, Dale Belman and John Heywood (1997) found empirical evidence that degrees do have an effect on salaries in the United States. Other results for U.S are Trostel and Walker (2004), Card (1994), Belman and Heywood (1991, 1997), Jaeger and Page (1996) and Park (1999). Crespo and Reis (2009) discuss the sheepskin effects for Brazil and include regional differences, gender and race. While Ferrer and Riddell (2002) find significant sheepskin effects for Canada Gibson (2000) do not find sheepskin effects in New Zealand.

Pons and Blanco (2005) and Pons (2006) discuss differences in sheepskin effects between public and private sectors for Spain and Münich et al. (2005) discuss the sheepskin effects for a transition economy like the Czech Republic.

In Colombia, Mora (2003), Mora and Muro (2008) discuss the effect of holding a schooling degree with the sheepskin equation and extend their analysis to a quantile regression in order to determine the effect of diplomas on the wages distribution for 2000.

3 Sheepskin equation and meta-analysis

In general, additional earnings from the complete range from school diplomas and certificates to Ph.D. degrees can be estimated from the following wage regression:

$$LnWh_i = \alpha_1 S_i + \alpha_2 exp_i + \alpha_3 exp^2{}_i + \beta DS_{high\ school,\ i} + \alpha_4 S_{high\ school,i}(S - S_{high\ school})_i + \mu_i \quad (1)$$

where $Ln(Wh)$ is the logarithm of hourly wages; S is the number of years of schooling; exp and exp^2 represent an individual's years of labor experience and its square; DS_t is a dummy variable for the year in which a given degree is earned; $S_{high\ school}$ is the year in which a degree is earned. In this article we only consider the high school diploma, and not the number of years to obtain the diploma. For example in Colombia the diploma is obtained after 11 years of schooling while in the USA it takes 12 years and in the UK 13 years of the schooling. The regression in (1) allows us to estimate a β value for each schooling diploma and its standard error (Hungerford and Solon, 1987; Mora and Muro, 2008).

In our analysis we collect the information provided by each article on the size of the effect of a high school diploma and its estimated standard error. The variability of the estimated size, β_i, from one study to another is assumed to be normally distributed around the mean effect β. This assumption let us a meta-analysis of the sheepskin equation and an estimation of the between-studies variance, τ^2, using the method of moments (DerSimonian and Laird, 1986). A fixed-effect or random-effect specification of the model does not provide any explanation as to the determinants of the variation between studies. To take into account factors that influence on the variability a vector of covariates is incorporated given place to a meta-analysis regression.

Meta-analysis has been used in medical and psychological studies on a regular basis (see, e.g., Sterling, 1959; Rosenthal, 1979; Begg and Berlin, 1988; Borenstein et al., 2009). It has also been utilized in economics by a number of authors, including among others Card and Krueger (1995a, 1995b) to study the effects of minimum wages; Dalhuisen et al. (2003) to analyze income elasticity of water demand; Jarrell and Stanley (2004) to review wage discrimination; Abreu et al. (2005) to quantify beta-type convergence; and Colegrave and Giles (2008) to study school cost functions.

Available literature on the topic of meta-analysis provides discussions of whether the aforementioned value could be biased due to the current publication policies of scientific journals. As an illustrative example, Card and Krueger (1995) and Stanley (2005) contend that there are at least three different sources of publication bias in economics (PET):

> "1 – Reviewers and editors may be predisposed to accept papers consistent with the conventional view. 2 – Researchers may use the presence of a conventionally expected result as a model selection test. 3 – Everyone may possess a predisposition to treat `statistically significant` results more favorably." Stanley (2005: 310–311)

To tackle this problem a test to identify the potential existence of the aforementioned publication bias has been proposed. The test is based on running the following regression:

$$effect_i = \tau_1 + \tau_0 Sd_i + e_i \tag{2}$$

where $effect_i$ is the effect of a school diploma on wages and Sd_i is its standard error. In the absence of publication bias, the estimate of the true effect will have a value close to τ_1, regardless of the standard error. Due to the presence of heteroscedasticity in equation (2) an estimating heteroscedasticity-corrected regression is

$$t_i = \tau_0 + \tau_1 (1/Sd)_i + e_i \tag{3}$$

Egger et al. (1997) posit that a test of significance of τ_0 is a test of publication bias that indicates the direction of the bias. Stanley (2008), on the other hand, argues that the observed effect comes close to τ when the number of observations tends to infinity and *Sd* tends to zero. Therefore, a test of τ_1 is a test for a true effect of a school diploma that goes beyond the systematic "contamination" that arises from publication biases. Hence, τ_1 is the “true” value of the effect of a school diploma.

4 Data

The search and coding strategy followed the MAER-NET protocols (Stanley et al., 2013). We first commenced with a comprehensive search of the literature. We began by searching JSTOR, SCOPUS, ISI-Web, EBSCO, and GOOGLE. Search keywords used were, but not limited to, “Sheepskin effects”, “Sheepskin equation”, “Diploma equation”, “Hungerford and Solon”. We stopped at 2011 because that year was the 25th anniversary of the seminal HS paper. The selection criteria were as follows. First, the study had to be published in a scholarly journal. We decided to exclude unpublished studies and focus only on the published literature “Published studies have gone through the referee process and are thus arguably of higher quality” Iamsiraroj and Doucouliagos (2015). This search strategy revealed 24 comparable published articles and 122 comparable estimates of the sheepskin effects that cover 15 different countries, including, among others, Libya, the Philippines, and Egypt. The estimates and various characteristics of the studies were coded as variables to be used in the MRA (Table 1)

On average, publications on the topic of sheepskin effects of a high school diploma show an additional return on a schooling degree of 19.8% with a standard deviation of 0.07. Brazil, where most studies have been carried out, is the country that evidences the greatest additional return on a school diploma. Canada and Sweden, on the other hand, are the countries with the lowest additional return. 44% of the studies consider gender differences (male vs. female), while 31% of the studies incorporate race differences (white vs. black, mestizo, and/or indigenous populations). Lastly, 72% of all studies were performed in countries on the American continents. When we compute *effect/Sd* the results show a minimum value of 0.01 and a maximum value of 33.75. At the 5% level of significance, 24 studies (19%) reject the sheepskin effect hypothesis, while 32 studies (26%) reject the hypothesis of the sheepskin effect at the 1% level of significance.

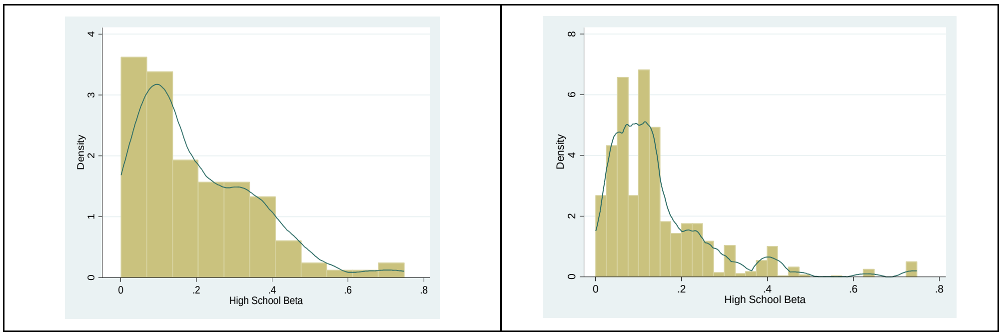
Table 1. Summary statistics of the sample.

Table 1. Data of Studies (Estimations)			
Variable	Percentage (%)	*n*	
Gender	44	122	
Race	32	122	
The Americas	72	122	
By Country	Beta (High School)	Standard Deviation (High School)	*n*
Brazil	0.34	0.08	36
Canada	0.05	0.005	7
Colombia	0.12	0.02	13
Egypt	0.16	0.15	2
Spain	0.34	0.10	10
United States	0.09	0.05	30
The Philippines	0.13	0.03	2
Japan	0.20	0.06	2
Libya	0.16	0.08	1
Mexico	0.10	0.02	2
New Zealand	0.07	0.08	6
Pakistan	0.28	0.41	3
The Czech Republic	0.22	0.08	4
Czechoslovakia	0.19	0.10	2
Sweden	0.05	0.01	2
Weighted Average or Total	0.20	0.07	122

Source: Authors' computation.

In Figure 1 (left) we show the histogram of the estimates of sheepskin effects and kernel estimation. The kernel apparently shows a bimodal distribution. When we weigh by the number of studies in each country, Figure 1 (right), the results apparently show bimodality in the distribution of the betas. This result is important in order to confirm the existence of publication bias. However, in the meta-analysis literature the most common graph to identify the presence of publication bias is the funnel plot (Iršová and Havránek 2013; Stanley and Doucouliagos 2010).

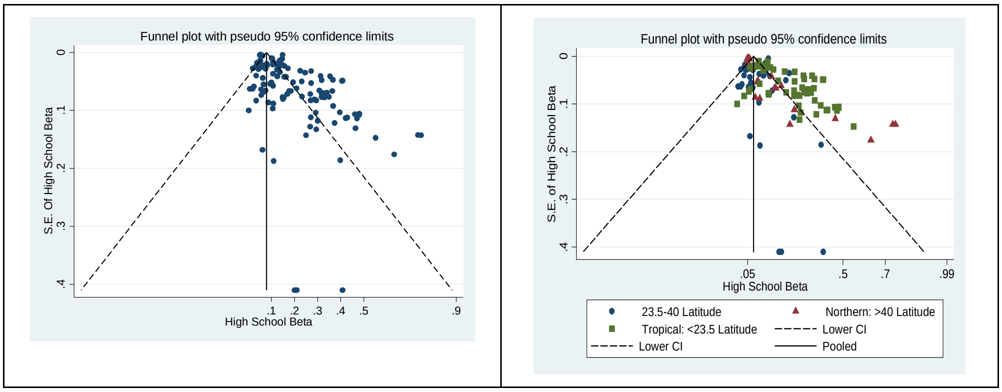
Figure 1. Histogram of estimates of beta



Source: Authors' calculations.

The funnel plot illustrates the position of the average effect of sheepskin effects on wages. Funnel plot is as the weighted average using each estimate's precision as the weight. Lack of symmetry in the funnel plot is consistent with publication bias; however, this is an informal test. The funnel plot in Figure 2 (right) considers the distance to equator. Both funnel plots show lack of symmetry. That is, publication bias is apparently present in the sheepskin equation estimates.

Figure 2. Funnel plot



Source: Authors' calculations.

5 Results

We carry out a meta-analysis in order to examine whether the studies share a common estimate for the effect of high school diplomas, in which case the fixed-effect method should be used, or whether there is a remarkable study heterogeneity, in which case the random-effect method should be employed.

Table 2 shows an estimated value of the school diploma effect of 8% when the fixed-effect method is used, while the estimated value is 15% with the random-effect model, and the between-studies variance is close to 0.03.

Although both estimates of the effect of a high school diploma are statistically significant, various studies in different places around the world and the estimates for men and women or people of different races show that there is a large heterogeneity from one study to another. Therefore, the random-effect method should be used for the analysis. In order to explore the issue of heterogeneity, a *Q* test of heterogeneity (Borenstein et al. 2009) was carried out yielding a value of 1307.384. Under the null hypothesis that the studies share an effect in common the test follows a chi-squared distribution with $k-1$ degrees of freedom. The rejection of the null hypothesis reinforces the appropriateness of using the random-effect method.

Higgins et al. (2003) use an index that aims to identify to what extent the variance is spurious and to what extent it is real. Their index, I^2, is on a relative scale ranging from 0 to 100 that is independent of the number of studies. If I^2 is close to zero, the observed variance is largely spurious, but if I^2 is close to 100, it

Table 2. Random and fixed meta-analysis

		τ^2	95% Confidence Interval		*Z* (value)	I^2	Number of Studies
Method	*High School*		Lower	Upper			
Fixed	0.08		0.08	0.09	54.9	90.7%	122
Random	0.15	0.003	0.13	0.16	22.3	90.7%	122

Source: Authors' computation.

makes sense to draw conjectures about the variance and about factors that could explain it. In other words, it is reasonable to carry out meta-regressions or subset-based analyses. Hence, according to our results in Table 2, it would make sense to incorporate covariates into our analysis.

The set of covariates included in our model are the distance to the equator, a dummy variable for gender (gender), a dummy variable for race (race), and a dummy variable for the Americas. Distance to the equator is a proxy for country development level and is frequently used in literature on economic development. For Hall and Jones (1999) "[it] is widely known that economies further from the equator are more successful in terms of per capita income"(p. 22). Acemoglu, et al. (2000) find that "Gallup et al. (1998) and Hall and Jones (1999) document the correlation between distance from the equator and economic performance

Table 3. Meta-analysis regressions (MRA)

	Meta-Reg[1]	Meta-Reg[2]	Meta-Reg[3]	Meta-Reg[4]
Distance to equator	−0.289***	−0.217***	−0.141**	−0.174***
	(0.065)	(0.046)	(0.042)	(0.042)
Gender		0.149***	0.079***	0.066**
		(0.017)	(0.020)	(0.020)
Race			0.114***	0.132***
			(0.025)	(0.025)
The Americas				−0.060**
				(0.020)
Constant	0.259***	0.170***	0.139***	0.199***
	(0.024)	(0.018)	(0.016)	(0.025)
τ^2	0.009	0.004	0.002	0.002
Q	953.6	780.9	640.2	634.7
I^2	0.874	0.848	0.816	0.816
R^2, adjusted	0.230	0.672	0.823	0.825
n	122	122	122	122

Source: Authors' computation. Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

(p. 1379). See also Nordhaus (1994), Theil and Donglin (1995). The estimation results are listed in Table 3 below.

Table 3 shows that the effect of a high school diploma decreases as the distance to the equator increases, is larger for men than for women and, when the race variable is included in the model, is greater for white people than for black, indigenous, and other populations. With respect to the geographic variable, the studies conducted on the American continents reveal that a diploma is recognized to a lesser extent than in other countries.

Publication biases and the true effect of a high school diploma

So far we have obtained estimates that as mentioned above are likely affected by publication bias. In order to test this hypothesis, we estimate the parameters in equations (2) and (3) above. Our results are in Table 4.

Equation (2) estimates are shown in the first column of Table 4. They suggest an effect of a high school diploma around 100%, which would mean a high school diploma would increase wages by 100%. The bias direction is positive (constant), which would imply most studies tend to report a larger effect than actually observed. Due to the presence of heteroscedasticity in equation (2) we use in our analysis equation (3) estimates in the second column of Table 5. They show a much more moderate effect of a high school diploma on wages of 5.8%. In addition, we can observe that the statistically significance do not change if we cluster using the number of estimates by article.

In order to discuss whether the effect as so far estimated is true, we run a regression between the *t*-values of each study and the sample size of the study (n). As shown by Stanley (2005), if there is indeed a true effect of high school diplomas, and given that $t = \beta/Sd$ when $\beta \neq 0$, in the regression $\ln(t) = \alpha_0 + \alpha_1 \ln(n)$ the value of α_1 will be statistically equal to ½. Our estimated value was 0.487 (third column in Table 4), and F for the hypothesis $\alpha_1 = ½$ was 0.06. This means that the observed effect of diplomas is statistically far from zero, which shows that the effect is true.

To solve the problem of measurement error in equation (2) (see Sterne et al., 2000; Macaskill et al., 2001) we estimate equation (3) with IV regression using as instrumental variable the inverse of the square root of the number of observations (Stanley, 2005).

Table 4. Publication Bias Estimates

	Publ. Bias[1]	Publ. Bias[2]	Publ. Bias[3]	Meta-Significance
Sheepskin Effect	0.997*	0.058***	0.058***	
	(0.392)	(0.014)	(0.017)	
ln(*n*)				0.487***
				(0.055)
Constant	0.130***	2.228***	2.228***	−3.330***
	(0.023)	(0.382)	(0.774)	(0.552)
Adj. R^2	0.195	0.538	0.538	0.399
Number of Cases	122	122	24	122

Source: Authors' computation. Note: * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 5. Publication Bias–Corrected Estimates

	Bias-corrected (1)	Bias-corrected (2)
Sheepskin Effect	0.088***	
	(0.017)	
Sheepskin Effect		0.079***
		(0.012)
(ISI or Scopus)/*Sd*		−0.051***
		(0.011)
(Year of publication − 1987)/*Sd*	−0.002*	
		(0.001)
Direction -Bias	1.126*	1.300***
	(0.449)	(0.337)
Adj. R^2	0.397	0.551
Number of Cases	122	122

Source: Authors' computation. Note: * p < 0.05, ** p < 0.01, *** p < 0.001.

The results in Table 5 show again that the bias is positive and that the “true” effect is close to 9%.[1] In Column (2) we incorporate a dummy variable for ISI or Scopus journal to take into account differences arising from the quality of the publication. The result shows that if the article was published in an ISI or Scopus journal the estimated sheepskin effect diminishes to only 2% (0.07−0.05).

Finally, we incorporate a variable to capture the likely obsolescence of the “sheepskin effect” paradigm and its impact on the size of estimated effect. The main reason for the obsolescence is the sheepskin effect theory itself: initial pay is determined by certification, but eventually workers are sorted into the most appropriate jobs on the basis of productivity, so that qualifications become less significant over time; this is the obsolescence of the sheepskin effect. Another possible explanation is that the “educational signal (sheepskin effects) decline over time as employers learn about the true productivity of their workers” Habermalz (2006: 125).[2]

To do that we construct a time-to-origin variable calculated as the time gap between the publication year of each study and the publication year of the seminal article by Hungerford and Solon (i.e., year of publication − 1987). In this case our results show a reduction of 0.2% per year of the sheepskin effects.[3]

6 Conclusions

There is no doubt that return is an important aspect of education. Following this train of thought, not only the amount of education (understood as the number of years of education received by a student) is important, but also the ability of

[1] A regression was also carried out with the 30th, 60th, and 90th percentiles of the distribution. The IV-quantile regression does not yield statistically different results between percentiles [F for the difference between percentiles 30 and 60 was 1.5 with a probability of 0.223, F for the difference between percentiles 30 and 90 was 0.04 with a probability of 0.83, and F for the difference between percentiles 60 and 90 was 0 with a probability of 0.979].

[2] Of course, it is possible that there are other reasons. For example, “the higher supply of more educated workers in the labor force reducing the importance of higher degrees as a signal of more productive workers” (Crespo and Reis, 2009).

[3] The total effect over the 25 years since the first publication of the sheepskin equation is around −5% (= −0.2% × 25).

education to signal productivity of individuals in the labor market (Spence, 2002; Mora and Muro, 2008).

One of the instruments used to estimate the capability of school diploma as a signal is the Sheepskin equation. A review of the literature on this topic shows the relevance of the study of sheepskin effects worldwide. Concerning the size of the effect we find a high heterogeneity in published results. We utilize a meta-analysis framework to offer a robust estimate of the effect of a high school diploma on wages. First of all, our research undoubtedly shows that there is an additional and statistically significant wage increase for individuals who have earned a high school diploma. The size of the effect, however, is not identical for all individuals but varies with their gender, race, or the continent they live in. In addition, interesting geographic differences can be appreciated when the published studies refer to countries' distances from the equator.

Our results also corroborate the presence of publication biases and provide evidence for the conclusion that most articles tend to overestimate the diploma effect. Finally, we present a publication bias–corrected meta-analysis regression that allows us to conclude that a high school diploma has an effect on wages of around 8%, with a substantial shrinkage when the article has a quality label (i.e., has been published in a journal with high impact – ISI or SCOPUS). In the latter case the size of the high school diploma effect is only 3%.

References

Arrow, K. J., (1973). The Theory of Discrimination, in Orley Ashenfelter and Albert Rees, eds., *Discrimination in labor markets.* Princeton NJ: Princeton University Press.

Abreu, M., H. deGroot and R. Florax (2005). A meta-analysis of beta-convergence: The legendary two-percent. *Journal of Economic Surveys*, 19(3): 389–420. http://onlinelibrary.wiley.com/doi/10.1111/j.0950-0804.2005.00253.x/full

Acemoglu, D., S. Johnson and J.A. Robinson (2000). The colonial origins of comparative development: An empirical investigation. *The American Economic Review*, 91(5): 1369–1401. https://www.aeaweb.org/articles.php?doi=10.1257/aer.91.5.1369

Becker, G,S. (1964) *Human capital*, 1st ed. New York: Columbia University Press for the National Bureau of Economic Research.

Begg, C. and J. Berlin (1988). Publication bias: A problem in interpreting medical data. *Journal of the Royal Statistical Society* (Series A): 151(3): 419–463. http://www.jstor.org/stable/2982993

Belman, D. and J.S. Heywood (1991). Sheepskin effects in the returns to education: An examination of women and minorities, *The Review of Economics and Statistics*, 73(4): 720–725. http://www.jstor.org/stable/2109413

Belman, D. and J.S. Heywood (1997). Sheepskin effects by cohort: Implications of job matching in a signaling model, *Oxford Economic Papers*, 49(4): 623–637. http://oep.oxfordjournals.org/content/49/4/623.abstract

Borenstein, M., L. Hedges, J. Higgins and H. Rothstein (2009*). Computing effect sizes for meta-analysis*. Chichester: John Wiley & Sons, Ltd.

Card, D. (1994). Earnings, schooling and ability revised. NBER Working Paper 4832. https://ideas.repec.org/p/nbr/nberwo/4832.html

Card, D. (1999). .The Causal Effect of Eduction on Earnings. In O. Ashenfelter, and D. Card, eds., *Handbook of Labor Economics*, Vol 3A. Amsterdam: Elsevier Science, North-Holland. http://www.sciencedirect.com/science/article/pii/S1573446399030114

Card, D. and A. Krueger (1995a). Time-series minimum wages studies: A meta-analysis. *American Economic Review*, 85(2): 238–243. https://ideas.repec.org/a/aea/aecrev/v85y1995i2p238-43.html

Card, D. and A. Krueger (1995b). *Myth and measurement: The New Economics of the minimum wage*. Princeton: Princeton University Press.

Crespo, A and M. Reis (2009). Sheepskin effects and the relationship between earnings and education: Analyzing their evolution over time in Brazil. *Revista Brasileira de Economia*, 63(3): 209–231. http://www.scielo.br/scielo.php?pid=S0034-71402009000300002&script=sci_arttext

Colegrave, A.D. and M.J. Giles. (2008). School cost functions: A meta-regression analysis. *Economics of Education Review*, 27(6): 688–696. http://www.sciencedirect.com/science/article/pii/S0272775707001215

Dalhuisen, J., R. Florax, H. deGroot and P. Nijkamp (2003). Price and income elasticity's of residential water demand: A meta-analysis. *Land Economics*, 79(2): 292–308. https://ideas.repec.org/a/uwp/landec/v79y2003i2p292-308.html

DerSimonian, R. and N. Laird (1986). Meta-analysis in clinical trials. *Controlled Clinical Trials*, 7(3): 177–188. http://www.ncbi.nlm.nih.gov/pubmed/3802833

Egger, M., G. Davey Smith, M. Schneider and C. Minder (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, 315: 629–634. http://www.bmj.com/content/315/7109/629

Ferrer, A. and C. Riddell (2002). The role of credentials in the canadian labour market. *Canadian Journal of Economics*, 35(4): 879–905. http://www.jstor.org/stable/3131840

Gallup, J, Sachs, J, and A. Mellinger (1998). *Geography and Economic Development', Proceedings of World Bank Annual Conference on Development Economics*, World Bank: Washington

Gibson, J. (2000). Sheepskin effects and the returns to education in New Zealand: Do they differ by ethnic groups? *New Zealand Economic Papers*, 34(2): 201–220. http://www.tandfonline.com/doi/pdf/10.1080/00779950009544323

Habermalz, S. (2006). More detail on the pattern of returns to educational signals. *Southern Economic Journal*, 73(1): 125–135. http://www.jstor.org/stable/20111878

Hall, R and C. Jones (1999). Why do some countries produce so much more output per worker than others? *The Quarterly Journal of Economics*, 114(1): 83–116. http://qje.oxfordjournals.org/content/114/1/83.abstract

Higgins, J., S. Thompson, J. Deeks and D. Altman (2003). Measuring inconsistencies in meta-analysis. *BMJ*, 327: 557–560. http://www.bmj.com/content/327/7414/557

Hungerford, T. and G. Solon (1987). Sheepskin effects in the returns to education. *The Review of Economics and Statistics*, 69(1): 175–177. http://www.jstor.org/stable/1937919

Iršová, Z., and Havránek, T. (2013). Determinants of horizontal spillovers from FDI: Evidence from a large meta-analysis. *World Development*, 42(February): 1–15. http://www.sciencedirect.com/science/article/pii/S0305750X12001908

Iamsiraroj, S and H. Doucouliagos (2015). Does Growth Attract FDI*? Economics: The Open-Access, Open-Assessment E-Journa*l, 9 (2015–19): 1–35. http://dx.doi.org/10.5018/economics-ejournal.ja.2015-19

Jarrell, S. and T. Stanley (2004). Declining bias and gender wage discrimination? A meta-regression analysis. *Journal of Human Resources*, 39(3): 828–838. http://www.jstor.org/stable/3558999

Jaeger, D.A. and M.E. Page (1996). Degrees matter: new evidence on sheepskin effects in the returns to education. *Review of Economics and Statistics*, 78(4): 733–740. http://www.jstor.org/stable/2109960

Kane, Thomas J. and C. E. Rouse, and D. Staiger (1999). Estimating Returns to Schooling When Schooling is Misreported. NBER Working Paper 7235. http://www.nber.org/papers/w7235

Macaskill, P., S. Walter and L. Irwig (2001). A comparison of methods to detect publication bias in meta-analysis. *Statistics in Medicine*, 20(4): 641–654. http://www.ncbi.nlm.nih.gov/pubmed/11223905

Nordhaus, W. (1994). Climate and economic development, Proceedings of the World Bank Annual Conference on Development Economics 1993, 1994: 355–376.

Mora, J.J. (2003). Screening and sheepskin effects in Colombia. *Colombian Economic Journal*, 1(1): 95–108. http://www.researchgate.net/publication/4806296_Sheepskin_Effects_and_Screening_in_Colombia

Mora, J.J. and J. Muro (2008). Sheepskin effects by cohorts in Colombia. *International Journal of Manpower*, 29(2): 111–121. http://dx.doi.org/10.1108/01437720810872686

Münich, D., J. Svejnar and K. Terrell (2005). Returns to human capital under the communist wage grid and during the transition to a market economy. *The Review of Economics and Statistics*, 87(1): 100–123. http://www.mitpressjournals.org/doi/abs/10.1162/0034653053327559#.VjdQNUbCr7I

Park, J. (1999). Estimation of sheepskin effects using the old and new measures of educational attainment in the current population survey. *Economics Letters*, 62(2): 237–240. http://www.sciencedirect.com/science/article/pii/S0165176598002262

Pons, E. (2006). Diploma effects by gender in the Spanish labour market. *Labour*, 20(1): 139–157. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9914.2006.00292.x/abstract

Pons, E., and J.M. Blanco (2005). Sheepskin effects in the Spanish labour market: A public-private sector Analysis. *Education Economics*, 13(3): 331–347. https://ideas.repec.org/a/taf/edecon/v13y2005i3p331-347.html

Rosenthal, R. (1979). The ‘file drawer problem’ and tolerance for null results. *Psychological Bulletin*, 86(3): 638–641. http://psycnet.apa.org/psycinfo/1979-27602-001

Spence, M. (1973). Job markets. *Quarterly Journal of Economics*, 87 (3): 355–374. http://qje.oxfordjournals.org/content/87/3/355.abstract

Spence, M. (2002). Signaling in retrospect and the informational structure of markets. *American Economic Review*, 92(3): 434–59. http://www.jstor.org/stable/3083350

Stanley, T. (2005). Beyond publication bias. *Journal of Economic Surveys*, 19(3): 309–345. http://onlinelibrary.wiley.com/doi/10.1111/j.0950-0804.2005.00250.x/abstract

Stanley, T. (2008). Meta-regression methods for detecting and estimating empirical effects in the presence of publication selection. *Oxford Bulletin of Economics and Statistics*, 70(1): 103–127. http://onlinelibrary.wiley.com/enhanced/doi/10.1111/j.1468-0084.2007.00487.x

Stanley, T.D., H. Doucouliagos, M. Giles, J.H. Heckemeyer, R.J. Johnston, P. Laroche, J.P. Nelson, M. Paldam, J. Poot, G. Pugh, R.S. Rosenberger and K. Rost. (2013). Meta-analysis of economics research reporting guidelines. *Journal of Economic Surveys*, 27(2): 390–394. http://onlinelibrary.wiley.com/wol1/doi/10.1111/joes.12008/abstract

Stanley, T.D. and H. Doucouliagos, (2010). Picture this: A simple graph that reveals much ado about research. *Journal of Economic Surveys*, 24(1): 170–191. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-6419.2009.00593.x/full

Sterling, T.D. (1959). Publication decisions and their possible effects on inferences drawn from tests of significance. *Journal of the American Statistical Association*, 54, 30–34. http://www.jstor.org/stable/2282137

Sterne, J., D. Gavaghan, and M. Egger (2000). Publication and related bias in meta-analysis: Power of statistical tests and prevalence in the literature. *Journal of Clinical Epidemiology*, 53(11): 1119–1129. http://www.ncbi.nlm.nih.gov/pubmed/11106885

Theil, H. and C. Dongling (1995). The equatorial Grand Canyon. *De Economist*, 143 (3): 317–327. http://link.springer.com/article/10.1007%2FBF01434011

Trostel, P. and I. Walker (2004) Sheepskin effects in work behavior. *Applied Economics*. 36(17): 959–1966. http://dx.doi.org/10.1080/0003684042000236057

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